

Is

# Dry Paint

## in your future?

*Dry paint film has gone on exterior molded car parts in a small way for several years. Now there's a big push on to make bumpers. Here's the latest.*

By Jan H. Schut, Senior Editor

The idea of dry paint isn't new. It's a multi-layer film that comes in rolls and replaces conventional paint. It grew out of decorative films with wood grain or marble designs that have been thermoformed for years for interior applications (the

and extrusions, all fairly flat.

Five years ago, injection molders and thermoformers began trying to stretch fluoropolymer films more. Three years ago the first commercial molded parts appeared on a U.S. car exterior. But they were nothing big or

two suppliers, Avery Dennison's Automotive Division in Troy, Mich., and Rexam Performance Products in Matthews, N.C.

Today, there are five suppliers vying to make big, highly reflective color-matched parts with metallic pigments and Class A finishes with high distinctness of image (DOI). The unofficial test of DOI is to hold an OEM's calling card against the paint finish and read it. Avery was first with color matched mirrors for several Ford models last year and a grill for the Fiesta in Europe, and is adding more colored parts in 1997 and 1998, including a body side molding for the Honda Accord.

"Immediate applications, being developed now, are for plastic parts for automotive

exteriors like claddings, body side moldings and bumpers. Model year '98 is the target," says Angela Dreis, marketing supervisor for Paint Replacement Film at 3M Co., St. Paul, Minn., which has worked on dry paint for years and started a joint venture



The brushed-aluminum trim on fascias and side moldings on GM's Sonoma bumper are still the biggest exterior dry-paint use. Source: General Motors

first thermoformed film on a car part was probably a wood-grained instrument panel on a 1974 Cadillac Seville). Dry paint on exterior car parts even goes back a ways, but on metal parts

showy—window posts and truck bumper fascia trim in colors Henry Ford could love, no-nonsense black and "brushed silver," a color like aluminum. Those films came from only

last year with Rexam. The big prize is bumpers.

Developmental bumper programs have become the worst kept secret in Detroit. All five dry paint suppliers work with all the Big Three, plus several European and Japanese auto makers (Mercedes Benz's MCC European Swatch car is said to be developing dry painted parts). Ford and General Motors are qualifying bumpers for limited 1998 model years. Chrysler is qualifying bumpers for the Neon, also in 1998. At least a dozen molders are involved in trials, including thermoforming processors and injection molders, to say nothing of tool makers and designers, who all have to learn a new process too.

The Neon program generated a lot of comparative interest because all the dry paint suppliers were invited to participate in bumper testing. Avery; Dorrie International in Norwalk, Conn.; and Kurz-Hastings Inc. in Philadelphia (a div. of Leonhard Kurz GmbH in Furth, Germany) accepted. Rexam declined (3M wasn't in the picture then). Chrysler supported a 300 bumper test program and has had six cars (three Avery, two Dorrie, one Kurz) on 100,000-mile road tests—



**A big push is on to make bumpers and body side moldings like this using dry paint film.**  
Source: Avery Dennison

with white, strawberry pearlescent and emerald green bumpers. The results were surprising and absolutely consistent, Chrysler said.

"The process is ready, the material is not," says John Horansky, Chrysler's product development engineer. "The 300 piece test was quite

revealing. Every material has a problem, and the failures were consistent on every part." That's positive, because a consistent problem can be focused on and fixed. Chrysler is now waiting for its three film suppliers to come back with modified samples. Material suppliers say some of the

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problems are the fault of prototype tooling, and easily corrected.

### What dry paint is

Exterior dry paint is fluoropolymer chemistry (interior dry paint uses a range of resins). It starts with clear, tough cast polyvinylidene fluoride (PVdF) film or polyvinyl fluoride (PVF) film, 1- or 2-mil thick, which makes a weather-and-abrasion-resistant Class A finish. This is coated on the back side with a polymer-based pigment. Colors are formulated to match specific conventional paint colors, with tinted clearcoats and different metallic flakes. "In general there are ways to match almost any paint," says Jerry Patton, marketing manager of Rexam.

Metallic dry paint, or "bright work" has a metal layer, color layer and possibly a support layer of polyester. Pigment is applied to the film, then coated with adhesive and backed with a substrate, selected to melt bond with the injection molded resin. Dry paint for ABS mirror housings has an ABS substrate; developmental films for TPO bumpers have TPO substrates.

Processing dry paint turned out to be less scary than molders had feared. It's like making a part backwards. Instead of injection molding a part, priming, painting and clearcoating it, dry paint does the same steps in reverse. It starts with the composite film of topcoat, pigment and substrate. That's shipped in rolls to a thermoformer, who vacuum forms it into a preform that's shaped like the part. The preform is trimmed, shipped to an injection molder, put on the core side of the cavity and filled to make the part.

Three processing technologies are used for dry paint: thermoforming followed by injection molding; thermoforming alone; and injection molding alone. Thermoforming followed by injection molding is the only commercial process so far. It uses a substrate 10-40 mils thick (0.25-1 mm), says Richard Castongay, Dorrie's R&D director, in a technical presentation on dry paint at the Society of Manufacturing Engineer's Thermoforming Innovations confer-

ence in April in Schaumburg, Ill. How thick depends on draw—deeper draws take thicker topcoat and pigment layers.

Thermoforming alone is develop-



Red is one of the toughest colors for dry paint to match with the rest of a conventionally painted car.

Source: Avery Dennison

mental, but promising because it saves the high cost of injection molds, handling and injection molding. It has been approved for a 1998 body side molding program for a truck, for which Avery and Dorrie are approved to supply 60-mil ABS backed, dry paint film. The idea is to make the substrate thick enough to become the part—40 to 125 mils (1-3.18mm) is possible.

Injection molding alone is the third alternative. It saves the cost of thermoforming tools, preforming, trimming and extra handling. "If a part is not very deep, you can put a flat sheet of coated film into the injection mold and injection mold directly against it without first preforming the shape," explains 3M's Dreis. This uses the thinnest substrate—5-20 mils (0.13-0.51 mm). The Rexam product was used this way on the Opel window pillar.

Any way it's done, dry paint involves no volatile organic compounds (VOCs), thinners, solvents,

sludge or waste, potentially a big savings over the capital and operating costs of conventional paint lines and emissions control. And Chrysler's Horansky says "Dry paint is a miracle of recyclability. If it's ground and pelletized, you can do 100% regrind." In extended trial runs with unextruded regrind, there's an occasional surface failure. If a chip of paint turns side ways, it makes a little bump under the new dry paint film.

And because the TPO and ABS substrate for dry paint have higher strength properties than the injection molding resin, mixing a percentage back actually helps retain properties. "The finish was reported to be excellent," says Thomas Ellison, technical team leader at Rexam. Dry painted parts can all be repaired by "feathering" new film over old, but for all practical purposes would have to be repainted.

### Roll out the paint

Three years ago there was only one company in the U.S. with dry paint on exterior molded plastic car parts. Now there are at least five fighting over applications. Here's a look at who offers what, how it's made, and where it's used.

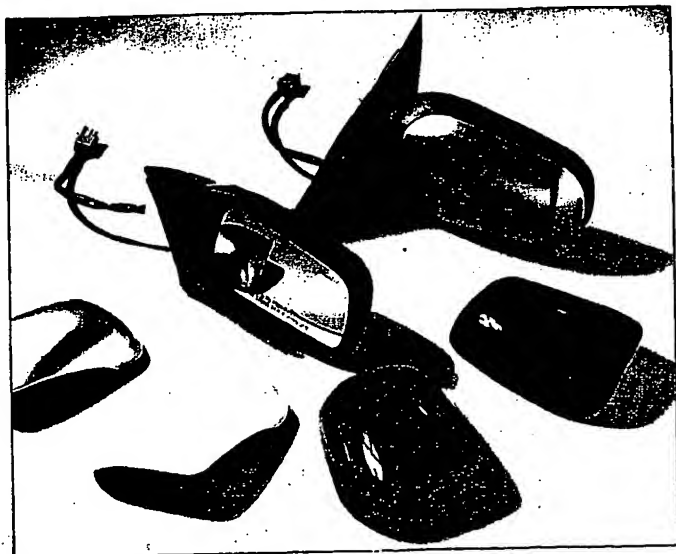
• Avery Dennison was first with commercial dry painted parts on cars in the U.S. and is still the biggest supplier of dry paint. It makes a line of PVdF acrylic film, called Avloy, with over 50 body colors. It typically rates high on durability, lower on gloss, which is in the 75-92° range. Its substrates are mostly ABS for side mir-

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rors, with TPO for developmental bumpers and side moldings. "But in five years I expect well over half will be TPO because of bumpers," says Lori Simoes, market manager for Avloy. Avery Dennison made interior woodgrain laminate films 20 years ago. It faces a patent challenge from Rexam in Federal District Court in North Carolina.

- Dorrie uses Tedlar PVF film (made by DuPont Co., Wilmington, Del.), then adds an acrylic or polyester pigment layer and a variety of substrates. The company was



**Dry-painted car mirrors** started in black and went to colors last year, using Avery's dry paint film, now in 50 colors.

just issued a patent for a decorative combination of bright work and color and expects to have a prototype soon. Dorrie traditionally supplies dry paint films for laminating directly to extruded profiles over PVC, ABS, nylon, TPO, polypropylene (PP) and ionomer. Now it is expanding into molded parts.

- Kurz has some OEM approvals, with more to come, so its material isn't fully commercial. Kurz is said to have material with higher gloss than anyone else—up to 94°—and the best gloss through all the manufacturing steps. Kurz works with Ford, Neon and others on developmental fascia programs. Kurz also uses DuPont Tedlar film, with an acrylic pigment layer. Its dry paint development work is all in the U.S., not Germany. The company is historically a supplier of film for transfer printing and hot-foil stamping.

- Rexam has had exterior Class-A-surface dry paint, called Fluorex, made of PVdF in the market for 15 years coating metal parts. Rexam made the first film-coated exterior plastic part, back in 1990 in Germany—a thermoformed "B" pillar for two models of Opel. This application won the 1991 SPE Automotive Division International Award for Innovation in Plastics.

Rexam holds significant patents for fluoropolymer film coating for base coat, clearcoat, formed article and distinction of image finish. Rexam is suing Avery in Federal District Court in North Carolina, scheduled next February. Rexam has had a joint venture with 3M for a year, for which Rexam makes dry paint and 3M does marketing and technical support.

- 3M is getting into dry paint by marketing Rexam material, and has some initial OEM approvals. For some five years, 3M tried to invent around Rexam's PVdF film patents and

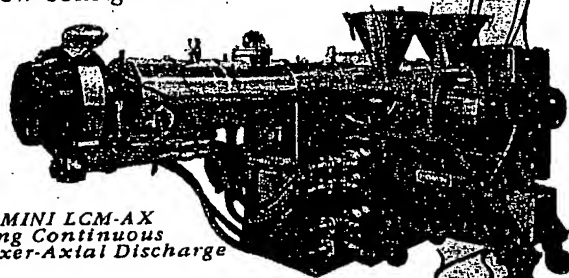
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finally decided to join Rexam instead. 3M distributes Rexam's film as ISF 1000U and 2000U (in-mold surfacing film), which has been on the market six months. ISF 1000 is for injection molding without preforming; ISF 2000 is for thermoforming, followed by injection molding.

### Molding dry paint

The first U.S. exterior molded part, and still the biggest, is the brushed-silver front bumper fascia trim and side cladding trim for General Motors'

clamping devices and core plugs to pull the film around the male mold to the back of the part and wrap the edges. Thermoforming oven types can be calrod, quartz or ceramic, so long as they can finely control temperature in small areas. What's important is to heat the substrate more than the color side.

If the film gets too warm, it dulls the gloss. Heat profiles are also slightly different (5-10°F) for different colors, and metallics resist heating. So it's important to test and store heat profiles for each color in thermoforming machine

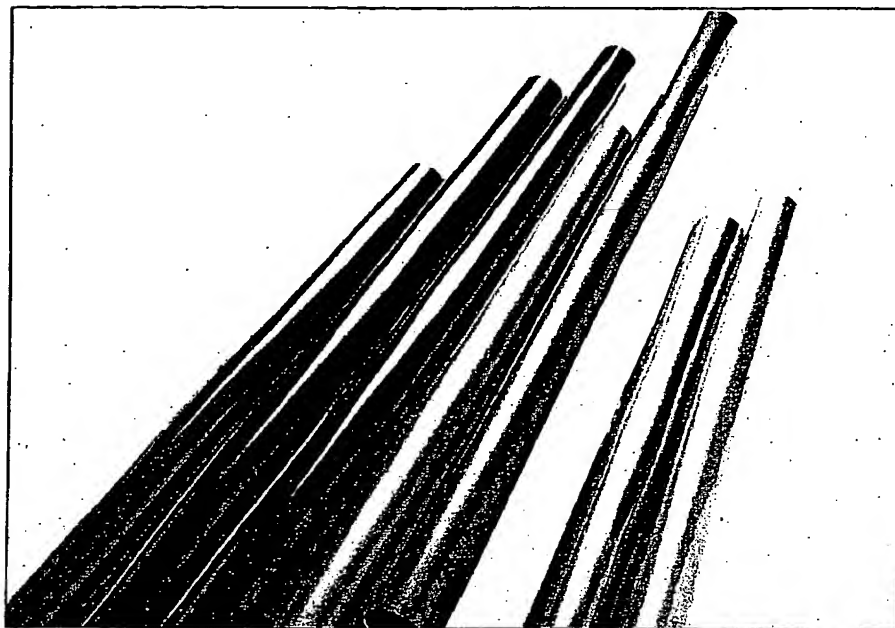
typing, but may not be suitable for production, 3M says.

Locating features are important "to make the thermoformed preform exactly fit the cavity of the injection mold. Depending on the shape of the part, we've used various configurations on the injection mold, including retractable fingers, locating tabs and pins," explains Joseph Pickl, CEO of Autoform, which formed the first U.S. production dry paint parts, as well as the Cadillac dashboard 25 years ago.

If the injection mold surface has any roughness, it transfers to the dry paint surface during the injection cycle. Thermoforming tools don't have to be chrome polished, and actually shouldn't be too smooth, or the substrate grabs. The injection mold "cores and cavities should be polished to a 400 or higher stone finish for a smooth DOI finish," 3M says. Four hundred is okay for a prototype tool, but when production tools were polished to 1200 grid, gloss went from about 80° to over 90°. Mold surface must be clean, smooth and free of dust. Blowing out the cavity with a puff of ionized air before each shot is one answer.

With or without a preform, injection tools generally don't use edge gates or edge vents, but there are exceptions. Vents are needed along the part bottom, breaks and deep draws. When dry paint film is put into an injection mold cavity, "two separate pockets of air are generated, one between the core and the film, and another between the cavity and the film. Both pockets of air must escape during the injection cycle or the film ruptures," 3M warns. This problem may also delay cycles by several seconds for slower mold closing.

Gates should be central, so the flow of plastic doesn't get around the front of the preform. A single gate is often best. Even wall thickness in a part design is important, 3M says, because if the outer edge of the part is thicker, resin will flood there and cause wrinkling. PW



**Paint by the yard.** Dry paint film for car parts avoids a lot of environmental costs of conventional paint and is recyclable. Source: 3M/Rexam

model year 1994 Sonoma truck. It won a Society of Plastics Engineers Decorative Division prize in 1993 for best plastic technology for its thermoformer Autoform Inc., Ann Arbor, Mich., and injection molder Arrow Molded Plastics Inc., Troy, Mich. The next model year came the first body color matching, for Ford's 1996 model year F-150 truck and EN-114 mirrors for Crown Victoria and Grand Marquis (the F-150 truck mirror was just re-released), molded by Display Pack, Grand Rapids, Mich., using Avery dry paint.

Dry paint requires special handling, part design, tooling and processing. A relatively small cohort of thermoforming processors in and around Detroit were the pioneers, including Autoform; Display Pack; and Peninsula Plastics, Auburn Hills, Mich. Vacuum forming dry paint preforms requires unusual

memory to speed color changes, Dorrie's Castonguay says.

Tooling for dry paint also has quirks. Tools need to be properly and evenly cooled. The injection cavity runs better under 100°F. If it uses two sets of tools, thermoforming and injection molds, they may not be the same size or surface, and the relationship isn't simple. "Whatever the math data says, the tool will be different," warns Dorrie's Castonguay. "You're looking to make a thermoformed part that's undersized. Then the injection molding forces it against the (cavity) wall. If the thermoformed part is too big, you have extra material, and you get wrinkles."

The forming tool is a male mold, so it can be shaved as needed after it's built. The injection molding tool should be designed for dry paint from the outset. Venting and gates in existing tools can be reworked for proto-

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